LABORATORY DATA CONSULTANTS, INC.
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Weston Solutions, Inc.
1090 King Georges Post Road, Suite 201
Edison, NJ 08837
ATTN: Ms. Smita Sumbaly
S.Sumbaly@WestonSolutions.com

March 4, 2020

SUBJECT: CRU Site, Data Validation

Dear Ms. Sumbaly,

Enclosed are the final validation reports for the fractions listed below. These SDGs were received on January 22, 2020. Attachment 1 is a summary of the samples that were reviewed for each analysis.

LDC Project #47161:

SDG #	Fraction
1900152, 1900153	Gamma Spectroscopy, Isotopic Uranium, Isotopic Thorium,

The data validation was performed under Level IV guidelines. The analyses were validated using the following documents as applicable to each method:

- Multi Agency Radiological Laboratory Analytical Protocols Manual; July 2004
- USEPA National Functional Guidelines for Inorganic Superfund Methods Data Review; January 2017

Please feel free to contact us if you have any questions.

Sincerely,

Pei Geng
pgeng@lab-data.com
Project Manager/Senior Chemist

Level IV

LDC #47161 (Weston Solutions, Inc.-Edison, NJ / CRU Site, NY)

LDC	SDG#	DATE REC'D	(3) DATE DUE	Gamma Spec. (NAREL)		U (NAREL)		Th (NAREL)																											
Matrix:	Water/Soil			W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S
A	1900152	01/22/20	02/12/20	0	19	0	19	0	19																										
B	1900153	01/22/20	02/12/20	2	0	2	0	2	0																										
Total	J/PG			2	19	2	19	2	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	63

Shaded cells indicate Level IV validation (all other cells are Level III validation). These sample counts do not include MS/MSD, and DUPs

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Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: CRU Site, NY

LDC Report Date: March 4, 2020

Parameters: Gamma Spectroscopy

Validation Level: Level IV

Laboratory: National Analytical Radiation Environmental Laboratory

Sample Delivery Group (SDG): 1900152

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
C008-SB001-036048-01	B9. 10537D	Soil	09/08/19
C008-SB001-036048-02	B9. 10538E	Soil	09/08/19
C008-SB001-108120-01	B9. 10539F	Soil	09/08/19
C008-SB002-024036-01	B9. 10540Y	Soil	09/08/19
C008-SB002-060072-01	B9. 10541Z	Soil	09/08/19
C008-SB003-000012-01	B9. 10542A	Soil	09/08/19
C008-SB003-072084-01	B9. 10543B	Soil	09/08/19
C008-SB004-012024-01	B9. 10544C	Soil	09/08/19
C008-SB004-084096-01	B9. 10545D	Soil	09/08/19
C008-SB005-036048-01	B9. 10546E	Soil	09/08/19
C008-SB005-060072-01	B9. 10547F	Soil	09/08/19
C008-SB006-024036-01	B9. 10548G	Soil	09/08/19
C008-SB006-060072-01	B9. 10549H	Soil	09/08/19
C008-SB007-024036-01	B9. 10550A	Soil	09/09/19
C008-SB007-060072-01	B9. 10551B	Soil	09/09/19
C008-SB008-048060-01	B9. 10552C	Soil	09/09/19
C008-SB008-084096-01	B9. 10553D	Soil	09/09/19
C008-SB009-000012-01	B9. 10554E	Soil	09/09/19
C008-SB009-072084-01	B9. 10555F	Soil	09/09/19
C008-SB001-036048-01DUP	B9. 10537DDUP	Soil	09/08/19

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the Multi Agency Radiological Laboratory Analytical Protocols (MARLAP) Manual (July 2004) and a modified outline of the USEPA National Functional Guidelines (NFG) for Inorganic Superfund Methods Data Review (January 2017). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Gamma Spectroscopy by Method NAREL GAM-01-RA

All sample results were subjected to Level IV data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The compound or analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The compound or analyte was analyzed for and positively identified by the laboratory; however the compound or analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The compound or analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected compound or analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition.

All technical holding time requirements were met.

II. Initial Calibration

All criteria for the initial calibration were met.

Counting and detector efficiency were determined for each detector and each radionuclide.

III. Continuing Calibration

Continuing calibration and background determination were performed at the required frequencies. Results were within laboratory control limits.

IV. Blanks

Laboratory blanks were analyzed as required by the method. Blank results contained less than the minimum detectable concentrations (MDC).

V. Field Blanks

Samples RB-190908 and RB-190909 (both from SDG 1900153) were identified as rinsate blanks. No contaminants were found.

VI. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicates (MSD) analyses were not required by the method.

VII. Duplicate Sample Analysis

Duplicate (DUP) sample analysis was performed on an associated project sample. Results were within QC limits.

VIII. Laboratory Control Samples

Laboratory control samples (LCS) were analyzed as required by the method. Percent recoveries (%R) were within QC limits.

IX. Field Duplicates

Samples C008-SB001-036048-01 and C008-SB001-036048-02 were identified as field duplicates. No results were detected in any of the samples with the following exceptions:

Isotope	Activity (pCi/g)		RPD
	C008-SB001-036048-01	C008-SB001-036048-02	
Bismuth-212	0.841	0.846	1
Bismuth-214	1.66	2.009	19
Cesium-137	0.0182	0.0208	13
Potassium-40	17.1	17.2	1
Lead-210	1.91	2.00	5
Lead-212	0.953	0.719	28
Lead-214	1.94	2.40	21
Radium-226	2.44	3.03	22
Radium-228	0.638	0.787	21
Thorium-234	0.491	0.532	8
Thallium-208	0.222	0.270	20

X. Minimum Detectable Concentrations

All minimum detectable concentrations (MDC) met reporting limits (RL).

XI. Sample Result Verification

All sample result verifications were acceptable.

XI. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

The quality control criteria reviewed were met and are considered acceptable.

CRU Site, NY
Gamma Spectroscopy - Data Qualification Summary - SDG 1900152

No Sample Data Qualified in this SDG

CRU Site, NY
Gamma Spectroscopy - Laboratory Blank Data Qualification Summary - SDG 1900152

No Sample Data Qualified in this SDG

CRU Site, NY
Gamma Spectroscopy - Field Blank Data Qualification Summary - SDG 1900152

No Sample Data Qualified in this SDG

LDC #: 47161A35 **VALIDATION COMPLETENESS WORKSHEET** Date: 3/3/20
SDG #: 1900152 Level IV Page: 1 of 2
Laboratory: National Analytical Radiation Environmental Laboratory Reviewer: a
2nd Reviewer: a

METHOD: Gamma Spectroscopy (NAREL GAM -01-RA)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A/A	
II.	Initial calibration	A	
III.	Calibration verification	A	
IV.	Laboratory Blanks	A	
V.	Field blanks	ND	RB= RB-190908, RB-190109
VI.	Matrix Spike/Matrix Spike Duplicates	N	Not required (1900153)
VII.	Duplicates	A	
VIII.	Laboratory control samples	A	LCS
IX.	Field duplicates	SW	(1,2)
X.	Minimum detectable activity (MDA)	A	
XI.	Sample result verification	A	
XII.	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID	Lab ID	Matrix	Date
1	C008-SB001-036048-01	B9. 10537D	Soil	09/08/19
2	C008-SB001-036048-02	B9. 10538E	Soil	09/08/19
3	C008-SB001-108120-01	B9. 10539F	Soil	09/08/19
4	C008-SB002-024036-01	B9. 10540Y	Soil	09/08/19
5	C008-SB002-060072-01	B9. 10541Z	Soil	09/08/19
6	C008-SB003-000012-01	B9. 10542A	Soil	09/08/19
7	C008-SB003-072084-01	B9. 10543B	Soil	09/08/19
8	C008-SB004-012024-01	B9. 10544C	Soil	09/08/19
9	C008-SB004-084096-01	B9. 10545D	Soil	09/08/19
10	C008-SB005-036048-01	B9. 10546E	Soil	09/08/19
11	C008-SB005-060072-01	B9. 10547F	Soil	09/08/19
12	C008-SB006-024036-01	B9. 10548G	Soil	09/08/19
13	C008-SB006-060072-01	B9. 10549H	Soil	09/08/19
14	C008-SB007-024036-01	B9. 10550A	Soil	09/09/19
15	C008-SB007-060072-01	B9. 10551B	Soil	09/09/19
16	C008-SB008-048060-01	B9. 10552C	Soil	09/09/19
17	C008-SB008-084096-01	B9. 10553D	Soil	09/09/19

LDC #: 47161A35 **VALIDATION COMPLETENESS WORKSHEET** Date: 3/3/20
SDG #: 1900152 Level IV Page: 2 of 2
Laboratory: National Analytical Radiation Environmental Laboratory Reviewer:
2nd Reviewer:

METHOD: Gamma Spectroscopy (NAREL GAM -01-RA)

18	C008-SB009-000012-01	B9. 10554E	Soil	09/09/19
19	C008-SB009-072084-01	B9. 10555F	Soil	09/09/19
20	C008-SB001-036048-01DUP	B9. 10537DDUP	Soil	09/08/19
21				
22				
23				

Notes:

LDC #: 47161A85

VALIDATION FINDINGS CHECKLIST

Reviewer: CP
2nd Reviewer: CP

Method: Radiochemistry (EPA Method See cover)

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
All technical holding times were met.	✓			
II. Calibration				
Were all instruments and detectors calibration as required?	✓			
Were NIST traceable standards used for all calibrations?	✓			
Was the check source identified by activity and radionuclide?	✓			
Were check sources including background counts analyzed at the requiried frequency and within laboratory control limits?	✓			
III. Blanks				
Were blank analyses performed as required?	✓			
Were any activities detected in the blanks greater than the minimum detectable activity (MDA)? If yes, please see the Blanks validation completeness worksheet.		✓		
IV. Matrix spikes and Duplicates				
Were a matrix spike (MS) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD or MS/DUP. Soil / Water.			✓	
Were the MS percent recoveries (%R) within the QC limits? If the sample concentration exceeded the spike concentration by a factor of 4 or more, no action was taken.			✓	
Was a duplicate sample anaylzed at the required frequency of 5% in this SDG?	✓			
Were all duplicate sample duplicate error rations (DER) ≤1.42?.	✓			
V. Laboratory control samples				
Was an LCS analyzed per analytical batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the 75-125%	✓			
VI. Sample Chemical/Carrier Recovery				
Was a tracer/carrier added to each sample?			✓	
Were tracer/carrier recoveries within the QC limits?			✓	
VII. Regional Quality Assurance and Quality Control				
Were performance evaluation (PE) samples performed?		✓	✓	
Were the performance evaluation (PE) samples within the acceptance limits?			✓	
VIII. Sample Result Verification				
Were activities adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✓			
Were the Minimum Detectable Activities (MDA) < RL?	✓			

Validation Area	Yes	No	NA	Findings/Comments
IX. Overall assessment of data				
Overall assessment of data was found to be acceptable.	✓			
X. Field duplicates				
Field duplicate pairs were identified in this SDG.	✓			
Target analytes were detected in the field duplicates.	✓			
XI. Field blanks				
Field blanks were identified in this SDG.	✓			
Target analytes were detected in the field blanks.		✓		

LDC# 47161A35

VALIDATION FINDINGS WORKSHEET
Field Duplicates

Page: 1 of 1
Reviewer:
2nd Reviewer:

Radiochemistry, Method see cover

Isotope	Activity (pCi/g)		RPD
	1	2	
Bi-212	0.841	0.846	1
Bi-214	1.66	2.009	19
Cs-137	0.0182	0.0208	13
K-40	17.1	17.2	1
Pb-210	1.91	2.00	5
Pb-212	0.953	0.719	28
Pb-214	1.94	2.40	21
Ra-226	2.44	3.03	22
Ra-228	0.638	0.787	21
Th-234	0.491	0.532	8
Tl-208	0.222	0.270	20

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LDC #: 47161A35

VALIDATION FINDINGS WORKSHEET
Level IV Recalculation Worksheet

Reviewer: [illegible]
2nd Reviewer: [illegible]

METHOD: Radiochemistry (Method: see cover)

Percent recoveries (%R) for a laboratory control sample, a matrix spike and a matrix spike duplicate sample were recaluculated using the following formula:

$\%R = \frac{Found}{True} \times 100$ Where, Found = activity of each analyte measured in the analysis of the sample.
True = activity of each analyte in the source.

A matrix spike and matrix spike duplicate relative percent difference (RPD) was recalculated using the following formula:

$RPD = \frac{|S-D|}{(S+D)/2} \times 100$ Where, S = Original sample activity
D = Duplicate sample activity

Sample ID	Type of Analysis	Analyte	Found/S (units)	True/D (units)	Recalculated %R or RPD	Reported %R or RPD	Acceptable (Y/N)
LCS	Laboratory control sample	Am-241	4340	4140	104.8	104.8	Y
	Matrix spike sample						
DO	Duplicate RPD	Ra-226	2.44	2.44	0	0.3	Y
	Chemical recovery						

Comments: _____

TOTCLC.35

LDC #: 47161A35

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Page: 1 of 1
Reviewer: C
2nd reviewer: [signature]

METHOD: Radiochemistry (Method: See cover)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

Y N N/A Have results been reported and calculated correctly?
Y N N/A Are results within the calibrated range of the instruments?

Analyte results for K-40 reported with a positive detect were recalculated and verified using the following equation:

Concentration = $\frac{(cpm - background)}{2.22 \times E \times SA \times Vol}$

E = Counter Efficiency
SA = Self-absorbance factor
Vol = Volume of sample

Recalculation:

3: K-40 = 11.23 pCi/g (directly from raw data)

#	Sample ID	Analyte	Reported Concentration (pCi/g)	Calculated Concentration (pCi/g)	Acceptable (Y/N)
	1	Bi-212	0.841	0.841	Y
	DUP 2	Bi-214/Pb-214	1.67	1.67	
	2 3	Cs-137	0.0208	0.0208	
	3 4	K-40	11.2	11.2	
	4 5	Pb-210	4.52	4.52	
	5 6	Pb-212	0.746	0.746	
	6 7	Pb-214	1.07	1.07	
	7 8	Ra-226	3.51	3.51	
	8 9	Ra-228	0.727	0.727	
	9 10	Th-228/Th-234	5.45	5.45	
	10 11	Tl-208	0.280	0.280	
	11 12	U-235	0.0773	0.0773	
	12 13	Bi-212	0.840	0.840	
	13 14	Bi-214	1.20	1.20	
	14 15	K-40	5.01	5.01	
	15 16	Pb-210	3.53	3.53	
	16 17	Pb-212	0.771	0.771	
	17 18	Pb-214	2.55	2.55	
	18 19	Ra-226	1.93	1.93	
	19	Ra-228	0.692	0.692	

Note:

RECALC.35

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: CRU Site, NY

LDC Report Date: March 4, 2020

Parameters: Isotopic Uranium

Validation Level: Level IV

Laboratory: National Analytical Radiation Environmental Laboratory

Sample Delivery Group (SDG): 1900152

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
C008-SB001-036048-01	B9. 10537D	Soil	09/08/19
C008-SB001-036048-02	B9. 10538E	Soil	09/08/19
C008-SB001-108120-01	B9. 10539F	Soil	09/08/19
C008-SB002-024036-01	B9. 10540Y	Soil	09/08/19
C008-SB002-060072-01	B9. 10541Z	Soil	09/08/19
C008-SB003-000012-01	B9. 10542A	Soil	09/08/19
C008-SB003-072084-01	B9. 10543B	Soil	09/08/19
C008-SB004-012024-01	B9. 10544C	Soil	09/08/19
C008-SB004-084096-01	B9. 10545D	Soil	09/08/19
C008-SB005-036048-01	B9. 10546E	Soil	09/08/19
C008-SB005-060072-01	B9. 10547F	Soil	09/08/19
C008-SB006-024036-01	B9. 10548G	Soil	09/08/19
C008-SB006-060072-01	B9. 10549H	Soil	09/08/19
C008-SB007-024036-01	B9. 10550A	Soil	09/09/19
C008-SB007-060072-01	B9. 10551B	Soil	09/09/19
C008-SB008-048060-01	B9. 10552C	Soil	09/09/19
C008-SB008-084096-01	B9. 10553D	Soil	09/09/19
C008-SB009-000012-01	B9. 10554E	Soil	09/09/19
C008-SB009-072084-01	B9. 10555F	Soil	09/09/19
C008-SB001-036048-01DUP	B9. 10537DDUP	Soil	09/08/19
C008-SB005-036048-01DUP	B9. 10546EDUP	Soil	09/08/19

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the Multi Agency Radiological Laboratory Analytical Protocols (MARLAP) Manual (July 2004) and a modified outline of the USEPA National Functional Guidelines (NFG) for Inorganic Superfund Methods Data Review (January 2017). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Isotopic Uranium by Method NAREL ACT-02F-U

All sample results were subjected to Level IV data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The compound or analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The compound or analyte was analyzed for and positively identified by the laboratory; however the compound or analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The compound or analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected compound or analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition.

All technical holding time requirements were met.

II. Initial Calibration

All criteria for the initial calibration were met.

Counting and detector efficiency were determined for each detector and each radionuclide.

III. Continuing Calibration

Continuing calibration and background determination were performed at the required frequencies. Results were within laboratory control limits.

IV. Blanks

Laboratory blanks were analyzed as required by the method. Blank results contained less than the minimum detectable concentrations (MDC).

V. Field Blanks

Samples RB-190908 and RB-190909 (both from SDG 1900153) were identified as rinsate blanks. No contaminants were found with the following exceptions:

Blank ID	Sampling Date	Isotope	Activity	Associated Samples
RB-190908	09/08/19	Uranium-234	0.136 pCi/L	C008-SB001-036048-01 C008-SB001-036048-02 C008-SB001-108120-01 C008-SB002-024036-01 C008-SB002-060072-01 C008-SB003-000012-01 C008-SB003-072084-01 C008-SB004-012024-01 C008-SB004-084096-01 C008-SB005-036048-01 C008-SB005-060072-01 C008-SB006-024036-01 C008-SB006-060072-01

Sample activities were compared to activities detected in the field blanks. The sample activities were either not detected or were significantly greater (>5X blank activity) than the activities found in the associated field blanks with the following exceptions:

Sample	Isotope	Reported Activity	Modified Final Activity
C008-SB001-036048-01	Uranium-234	0.444 pCi/L	0.444U pCi/L
C008-SB001-036048-02	Uranium-234	0.420 pCi/L	0.420U pCi/L
C008-SB001-108120-01	Uranium-234	0.815 pCi/L	0.815U pCi/L
C008-SB002-024036-01	Uranium-234	0.688 pCi/L	0.688U pCi/L
C008-SB002-060072-01	Uranium-234	0.527 pCi/L	0.527U pCi/L
C008-SB003-000012-01	Uranium-234	0.407 pCi/L	0.407U pCi/L
C008-SB003-072084-01	Uranium-234	1.75 pCi/L	1.75U pCi/L
C008-SB004-012024-01	Uranium-234	0.506 pCi/L	0.506U pCi/L
C008-SB004-084096-01	Uranium-234	1.91 pCi/L	1.91U pCi/L
C008-SB005-036048-01	Uranium-234	0.725 pCi/L	0.725U pCi/L
C008-SB005-060072-01	Uranium-234	0.921 pCi/L	0.921U pCi/L
C008-SB006-024036-01	Uranium-234	0.377 pCi/L	0.377U pCi/L
C008-SB006-060072-01	Uranium-234	1.10 pCi/L	1.10U pCi/L

VI. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicates (MSD) analyses were not required by the method.

VII. Duplicate Sample Analysis

Duplicate (DUP) sample analysis was performed on an associated project sample. Results were within QC limits.

VIII. Laboratory Control Samples

Laboratory control samples (LCS) were analyzed as required by the method. Percent recoveries (%R) were within QC limits.

IX. Field Duplicates

Samples C008-SB001-036048-01 and C008-SB001-036048-02 were identified as field duplicates. No results were detected in any of the samples with the following exceptions:

Isotope	Activity (pCi/g)		RPD
	C008-SB001-036048-01	C008-SB001-036048-02	
Uranium-234	0.444	0.420	6
Uranium-235	0.0287	0.0357	22
Uranium-238	0.556	0.355	44

X. Minimum Detectable Concentrations

All minimum detectable concentrations (MDC) met reporting limits (RL).

XI. Sample Result Verification

All sample result verifications were acceptable.

XI. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

Due to rinsate blank contamination, data were qualified as not detected in thirteen samples.

The quality control criteria reviewed, other than those discussed above, were met and are considered acceptable.

CRU Site, NY
Isotopic Uranium - Data Qualification Summary - SDG 1900152

No Sample Data Qualified in this SDG

CRU Site, NY
Isotopic Uranium - Laboratory Blank Data Qualification Summary - SDG 1900152

No Sample Data Qualified in this SDG

CRU Site, NY
Isotopic Uranium - Field Blank Data Qualification Summary - SDG 1900152

Sample	Isotope	Modified Final Activity	A or P
C008-SB001-036048-01	Uranium-234	0.444U pCi/L	A
C008-SB001-036048-02	Uranium-234	0.420U pCi/L	A
C008-SB001-108120-01	Uranium-234	0.815U pCi/L	A
C008-SB002-024036-01	Uranium-234	0.688U pCi/L	A
C008-SB002-060072-01	Uranium-234	0.527U pCi/L	A
C008-SB003-000012-01	Uranium-234	0.407U pCi/L	A
C008-SB003-072084-01	Uranium-234	1.75U pCi/L	A
C008-SB004-012024-01	Uranium-234	0.506U pCi/L	A
C008-SB004-084096-01	Uranium-234	1.91U pCi/L	A
C008-SB005-036048-01	Uranium-234	0.725U pCi/L	A
C008-SB005-060072-01	Uranium-234	0.921U pCi/L	A
C008-SB006-024036-01	Uranium-234	0.377U pCi/L	A
C008-SB006-060072-01	Uranium-234	1.10U pCi/L	A

LDC #: 47161A59 **VALIDATION COMPLETENESS WORKSHEET** Date: 3/3/20
SDG #: 1900152 Level IV Page: 1 of 2
Laboratory: National Analytical Radiation Environmental Laboratory Reviewer: [illegible]
2nd Reviewer: [illegible]

METHOD: Isotopic Uranium (NAREL ACT-02F-U)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A/A	
II.	Initial calibration	A	
III.	Calibration verification	A	
IV.	Laboratory Blanks	A	
V.	Field blanks	SW	RB= RB-190908, RB-190909
VI.	Matrix Spike/Matrix Spike Duplicates	N	not required (1900153)
VII.	Duplicates	A	
VIII.	Laboratory control samples	A	LCS
IX.	Field duplicates	SW	(1,2)
X.	Tracer Recovery	A	
XI.	Minimum detectable activity (MDA)	A	
XII.	Sample result verification	A	
XIII.	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID	Lab ID	Matrix	Date
1	C008-SB001-036048-01	B9. 10537D	Soil	09/08/19
2	C008-SB001-036048-02	B9. 10538E	Soil	09/08/19
3	C008-SB001-108120-01	B9. 10539F	Soil	09/08/19
4	C008-SB002-024036-01	B9. 10540Y	Soil	09/08/19
5	C008-SB002-060072-01	B9. 10541Z	Soil	09/08/19
6	C008-SB003-000012-01	B9. 10542A	Soil	09/08/19
7	C008-SB003-072084-01	B9. 10543B	Soil	09/08/19
8	C008-SB004-012024-01	B9. 10544C	Soil	09/08/19
9	C008-SB004-084096-01	B9. 10545D	Soil	09/08/19
10	C008-SB005-036048-01	B9. 10546E	Soil	09/08/19
11	C008-SB005-060072-01	B9. 10547F	Soil	09/08/19
12	C008-SB006-024036-01	B9. 10548G	Soil	09/08/19
13	C008-SB006-060072-01	B9. 10549H	Soil	09/08/19
14	C008-SB007-024036-01	B9. 10550A	Soil	09/09/19
15	C008-SB007-060072-01	B9. 10551B	Soil	09/09/19
16	C008-SB008-048060-01	B9. 10552C	Soil	09/09/19

LDC #: 47161A59 **VALIDATION COMPLETENESS WORKSHEET** Date: 3/3/20
SDG #: 1900152 Level IV Page: 2 of 2
Laboratory: National Analytical Radiation Environmental Laboratory Reviewer:
2nd Reviewer:

METHOD: Isotopic Uranium (NAREL ACT-02F-U)

17	C008-SB008-084096-01	B9. 10553D	Soil	09/09/19
18	C008-SB009-000012-01	B9. 10554E	Soil	09/09/19
19	C008-SB009-072084-01	B9. 10555F	Soil	09/09/19
20	C008-SB001-036048-01DUP	B9. 10537DDUP	Soil	09/08/19
21	C008-SB005-036048-01DUP	B9. 10546EDUP	Soil	09/08/19
22				
23				
24				

Notes:

Method: Radiochemistry (EPA Method See cover)

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
All technical holding times were met.	✓			
II. Calibration				
Were all instruments and detectors calibration as required?	✓			
Were NIST traceable standards used for all calibrations?	✓			
Was the check source identified by activity and radionuclide?	✓			
Were check sources including background counts analyzed at the requiried frequency and within laboratory control limits?	✓			
III. Blanks				
Were blank analyses performed as required?	✓			
Were any activities detected in the blanks greater than the minimum detectable activity (MDA)? If yes, please see the Blanks validation completeness worksheet.		✓		
IV. Matrix spikes and Duplicates				
Were a matrix spike (MS) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD or MS/DUP. Soil / Water.			✓	
Were the MS percent recoveries (%R) within the QC limits? If the sample concentration exceeded the spike concentration by a factor of 4 or more, no action was taken.			✓	
Was a duplicate sample anaylzed at the required frequency of 5% in this SDG?	✓			
Were all duplicate sample duplicate error rations (DER) <1.42?.	✓			
V. Laboratory control samples				
Was an LCS analyzed per analytical batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the 75-125%				
VI. Sample Chemical/Carrier Recovery				
Was a tracer/carrier added to each sample?	✓			
Were tracer/carrier recoveries within the QC limits?	✓			
VII. Regional Quality Assurance and Quality Control				
Were performance evaluation (PE) samples performed?		✓		
Were the performance evaluation (PE) samples within the acceptance limits?			✓	
VIII. Sample Result Verification				
Were activities adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✓			
Were the Minimum Detectable Activities (MDA) < RL?	✓			

Validation Area	Yes	No	NA	Findings/Comments
IX. Overall assessment of data				
Overall assessment of data was found to be acceptable.	✓			
X. Field duplicates				
Field duplicate pairs were identified in this SDG.	✓			
Target analytes were detected in the field duplicates.	✓			
XI. Field blanks				
Field blanks were identified in this SDG.	✓			
Target analytes were detected in the field blanks.		✓		

LDC #: 47161A59

VALIDATION FINDINGS WORKSHEET
Field Blanks

Reviewer:
2nd Reviewer:

METHOD: Radiochemistry, Method See Cover
Blank units: pCi/L **Associated sample units:** pCi/L
Sampling date: 9/8/19
Field blank type: (circle one) Field Blank / Rinsate / Other: Associated Samples: 1-13 (Qualify B)

Analyte	Blank ID	Action Limit	Sample Identification												
	RB-190908		1	2	3	4	5	6	7	8	9	10	11	12	13
U-234	0.136		0.444	0.420	0.815	0.688	0.527	0.407	1.75	0.506	1.91	0.725	0.921	0.377	1.10

CIRCLED RESULTS WERE NOT QUALIFIED. ALL RESULTS NOT CIRCLED WERE QUALIFIED BY THE FOLLOWING STATEMENT:
Samples with analyte concentrations within five times the associated field blank concentration are listed above, these sample results were qualified as not detected, "U".

LDC# 47161A59

VALIDATION FINDINGS WORKSHEET
Field Duplicates

Page: of
Reviewer:
2nd Reviewer:

Radiochemistry, Method see cover

Isotope	Activity (pCi/g)		RPD
	1	2	
U-234	0.444	0.420	6
U-235	0.0287	0.0357	22
U-238	0.556	0.355	44

V:\FIELD DUPLICATES\Field Duplicates\FD_inorganic\2020\47161A59.wpd

LDC #: 47161A59

VALIDATION FINDINGS WORKSHEET
Level IV Recalculation Worksheet

Reviewer: QA
2nd Reviewer: QA

METHOD: Radiochemistry (Method: see cover)

Percent recoveries (%R) for a laboratory control sample, a matrix spike and a matrix spike duplicate sample were recaluculated using the following formula:

%R = Found / True x 100 Where, Found = activity of each analyte measured in the analysis of the sample.
True = activity of each analyte in the source.

A matrix spike and matrix spike duplicate relative percent difference (RPD) was recalculated using the following formula:

RPD = |S-D| / (S+D)/2 x 100 Where, S = Original sample activity
D = Duplicate sample activity

Sample ID	Type of Analysis	Analyte	Found/S (units)	True/D (units)	Recalculated %R or RPD	Reported %R or RPD	Acceptable (Y/N)
LCS	Laboratory control sample	U-235	0.0780	0.0930	83.9	83.8	Y
	Matrix spike sample						
20	Duplicate RPD	U-234	0.444	0.404	9.4	9.4	Y
1	Chemical recovery	U-232	%R directly from raw data		73.4	73.43	Y

Comments: _____

TOTCLC.35

LDC #: 47161A59

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Page: 1 of 1
Reviewer: [illegible]
2nd reviewer: [illegible]

METHOD: Radiochemistry (Method: see cover)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

Y N N/A Have results been reported and calculated correctly?
Y N N/A Are results within the calibrated range of the instruments?

Analyte results for U-235 reported with a positive detect were recalculated and verified using the following equation:

Concentration = $\frac{(cpm - background)}{2.22 \times E \times SA \times Vol}$

E = Counter Efficiency
SA = Self-absorbance factor
Vol = Volume of sample

Recalculation:

6: $11.667 / 2.22(0.835)(0.1685)(0.736)(1000 min)(1018 g) =$

0.04985 pCi/g

#	Sample ID	Analyte	Reported Concentration (pCi/g)	Calculated Concentration (pCi/g)	Acceptable (Y/N)
	1	U-234	0.444	0.464	Y
	2	U-235	0.057	~~0.0515~~ 0.0375	
	3	U-238	0.696	0.759	
	4	U-234	0.688	0.793	
	5	U-238	0.604	0.666	
	6	U-235	0.0480	0.0499	
	7	U-234	1.75	2.39	
	8	U-238	0.529	0.543	
	9	U-235	0.0641	0.0815	
	10	U-234	0.725	0.817	
	11	U-235	0.0304	0.0337	
	12	U-238	0.379	0.385	
	13	U-234	1.10	1.28	
	14	U-235	0.0400	0.0581	
	15	U-238	0.567	0.610	
	16	U-234	0.439	0.447	
	17	U-235	0.0776	0.233	
	18	U-238	0.540	0.558	
	19	U-234	0.452	0.483	↓

Note: _____

RECALC.35

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: CRU Site, NY

LDC Report Date: March 4, 2020

Parameters: Isotopic Thorium

Validation Level: Level IV

Laboratory: National Analytical Radiation Environmental Laboratory

Sample Delivery Group (SDG): 1900152

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
C008-SB001-036048-01	B9. 10537D	Soil	09/08/19
C008-SB001-036048-02	B9. 10538E	Soil	09/08/19
C008-SB001-108120-01	B9. 10539F	Soil	09/08/19
C008-SB002-024036-01	B9. 10540Y	Soil	09/08/19
C008-SB002-060072-01	B9. 10541Z	Soil	09/08/19
C008-SB003-000012-01	B9. 10542A	Soil	09/08/19
C008-SB003-072084-01	B9. 10543B	Soil	09/08/19
C008-SB004-012024-01	B9. 10544C	Soil	09/08/19
C008-SB004-084096-01	B9. 10545D	Soil	09/08/19
C008-SB005-036048-01	B9. 10546E	Soil	09/08/19
C008-SB005-060072-01	B9. 10547F	Soil	09/08/19
C008-SB006-024036-01	B9. 10548G	Soil	09/08/19
C008-SB006-060072-01	B9. 10549H	Soil	09/08/19
C008-SB007-024036-01	B9. 10550A	Soil	09/09/19
C008-SB007-060072-01	B9. 10551B	Soil	09/09/19
C008-SB008-048060-01	B9. 10552C	Soil	09/09/19
C008-SB008-084096-01	B9. 10553D	Soil	09/09/19
C008-SB009-000012-01	B9. 10554E	Soil	09/09/19
C008-SB009-072084-01	B9. 10555F	Soil	09/09/19
C008-SB001-036048-01DUP	B9. 10537DDUP	Soil	09/08/19
C008-SB005-036048-01DUP	B9. 10546EDUP	Soil	09/08/19

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the Multi Agency Radiological Laboratory Analytical Protocols (MARLAP) Manual (July 2004) and a modified outline of the USEPA National Functional Guidelines (NFG) for Inorganic Superfund Methods Data Review (January 2017). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Isotopic Thorium by Method NAREL ACT-02F-TH

All sample results were subjected to Level IV data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The compound or analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The compound or analyte was analyzed for and positively identified by the laboratory; however the compound or analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The compound or analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected compound or analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition.

All technical holding time requirements were met.

II. Initial Calibration

All criteria for the initial calibration were met.

Counting and detector efficiency were determined for each detector and each radionuclide.

III. Continuing Calibration

Continuing calibration and background determination were performed at the required frequencies. Results were within laboratory control limits.

IV. Blanks

Laboratory blanks were analyzed as required by the method. Blank results contained less than the minimum detectable concentrations (MDC).

V. Field Blanks

Samples RB-190908 and RB-190909 (both from SDG 1900153) were identified as rinsate blanks. No contaminants were found.

VI. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicates (MSD) analyses were not required by the method.

VII. Duplicate Sample Analysis

Duplicate (DUP) sample analysis was performed on an associated project sample. Results were within QC limits.

VIII. Laboratory Control Samples

Laboratory control samples (LCS) were analyzed as required by the method. Percent recoveries (%R) were within QC limits.

IX. Field Duplicates

Samples C008-SB001-036048-01 and C008-SB001-036048-02 were identified as field duplicates. No results were detected in any of the samples with the following exceptions:

Isotope	Activity (pCi/g)		RPD
	C008-SB001-036048-01	C008-SB001-036048-02	
Thorium-227	0.0293	0.0603	69
Thorium-228	0.632	0.597	6
Thorium-230	0.601	0.643	7
Thorium-232	0.573	0.567	1

X. Minimum Detectable Concentrations

All minimum detectable concentrations (MDC) met reporting limits (RL).

XI. Sample Result Verification

All sample result verifications were acceptable.

XI. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

The quality control criteria reviewed were met and are considered acceptable.

CRU Site, NY
Isotopic Thorium - Data Qualification Summary - SDG 1900152

No Sample Data Qualified in this SDG

CRU Site, NY
Isotopic Thorium - Laboratory Blank Data Qualification Summary - SDG 1900152

No Sample Data Qualified in this SDG

CRU Site, NY
Isotopic Thorium - Field Blank Data Qualification Summary - SDG 1900152

No Sample Data Qualified in this SDG

LDC #: 47161A73 **VALIDATION COMPLETENESS WORKSHEET** Date: 3/3/20
SDG #: 1900152 Level IV Page: 1 of 2
Laboratory: National Analytical Radiation Environmental Laboratory Reviewer:
2nd Reviewer:

METHOD: Isotopic Thorium (NAREL ACT-02F-TH)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A/A	
II.	Initial calibration	A	
III.	Calibration verification	A	
IV.	Laboratory Blanks	A	
V.	Field blanks	ND	RB = RB-190908, RB-190909
VI.	Matrix Spike/Matrix Spike Duplicates	N	Not required (1900153)
VII.	Duplicates	A	
VIII.	Laboratory control samples	A	LCS
IX.	Field duplicates	SW	(1,2)
X.	Tracer Recovery	A	
XI.	Minimum detectable activity (MDA)	A	
XII.	Sample result verification	A/N	
XIII	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID	Lab ID	Matrix	Date
1	C008-SB001-036048-01	B9. 10537D	Soil	09/08/19
2	C008-SB001-036048-02	B9. 10538E	Soil	09/08/19
3	C008-SB001-108120-01	B9. 10539F	Soil	09/08/19
4	C008-SB002-024036-01	B9. 10540Y	Soil	09/08/19
5	C008-SB002-060072-01	B9. 10541Z	Soil	09/08/19
6	C008-SB003-000012-01	B9. 10542A	Soil	09/08/19
7	C008-SB003-072084-01	B9. 10543B	Soil	09/08/19
8	C008-SB004-012024-01	B9. 10544C	Soil	09/08/19
9	C008-SB004-084096-01	B9. 10545D	Soil	09/08/19
10	C008-SB005-036048-01	B9. 10546E	Soil	09/08/19
11	C008-SB005-060072-01	B9. 10547F	Soil	09/08/19
12	C008-SB006-024036-01	B9. 10548G	Soil	09/08/19
13	C008-SB006-060072-01	B9. 10549H	Soil	09/08/19
14	C008-SB007-024036-01	B9. 10550A	Soil	09/09/19
15	C008-SB007-060072-01	B9. 10551B	Soil	09/09/19
16	C008-SB008-048060-01	B9. 10552C	Soil	09/09/19

LDC #: 47161A73 **VALIDATION COMPLETENESS WORKSHEET** Date: 3/3/20
SDG #: 1900152 Level IV Page: 2 of 2
Laboratory: National Analytical Radiation Environmental Laboratory Reviewer: G
2nd Reviewer: G

METHOD: Isotopic Thorium (NAREL ACT-02F-TH)

17	C008-SB008-084096-01	B9. 10553D	Soil	09/09/19
18	C008-SB009-000012-01	B9. 10554E	Soil	09/09/19
19 ✓	C008-SB009-072084-01	B9. 10555F	Soil	09/09/19
20	C008-SB001-036048-01DUP	B9. 10537DDUP	Soil	09/08/19
21	C008-SB005-036048-01DUP	B9. 10546EDUP	Soil	09/08/19
22				
23				
24				

Notes:

Method: Radiochemistry (EPA Method See cover)

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
All technical holding times were met.	✓			
II. Calibration				
Were all instruments and detectors calibration as required?	✓			
Were NIST traceable standards used for all calibrations?	✓			
Was the check source identified by activity and radionuclide?	✓			
Were check sources including background counts analyzed at the requiried frequency and within laboratory control limits?	✓			
III. Blanks				
Were blank analyses performed as required?	✓			
Were any activities detected in the blanks greater than the minimum detectable activity (MDA)? If yes, please see the Blanks validation completeness worksheet.		✓		
IV. Matrix spikes and Duplicates				
Were a matrix spike (MS) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD or MS/DUP. Soil / Water.			✓	
Were the MS percent recoveries (%R) within the QC limits? If the sample concentration exceeded the spike concentration by a factor of 4 or more, no action was taken.			✓	
Was a duplicate sample anaylzed at the required frequency of 5% in this SDG?	✓			
Were all duplicate sample duplicate error rations (DER) <1.42?.	✓			
V. Laboratory control samples				
Was an LCS analyzed per analytical batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the 75-125%	✓	✓		
VI. Sample Chemical/Carrier Recovery				
Was a tracer/carrier added to each sample?	✓			
Were tracer/carrier recoveries within the QC limits?	✓			
VII. Regional Quality Assurance and Quality Control				
Were performance evaluation (PE) samples performed?		✓		
Were the performance evaluation (PE) samples within the acceptance limits?			✓	
VIII. Sample Result Verification				
Were activities adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✓			
Were the Minimum Detectable Activities (MDA) < RL?	✓			

Validation Area	Yes	No	NA	Findings/Comments
IX. Overall assessment of data				
Overall assessment of data was found to be acceptable.	✓			
X. Field duplicates				
Field duplicate pairs were identified in this SDG.	✓			
Target analytes were detected in the field duplicates.	✓			
XI. Field blanks				
Field blanks were identified in this SDG.	✓			
Target analytes were detected in the field blanks.		✓		

LDC# 47161A73

VALIDATION FINDINGS WORKSHEET
Field Duplicates

Reviewer:
2nd Reviewer:

Radiochemistry, Method see cover

Isotope	Activity (pCi/g)		RPD
	1	2	
Th-227	0.0293	0.0603	69
Th-228	0.632	0.597	6
Th-230	0.601	0.643	7
Th-232	0.573	0.567	1

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LDC #: 47161A73

VALIDATION FINDINGS WORKSHEET
Level IV Recalculation Worksheet

Reviewer: AR
2nd Reviewer: X

METHOD: Radiochemistry (Method: see cover)

Percent recoveries (%R) for a laboratory control sample, a matrix spike and a matrix spike duplicate sample were recaluculated using the following formula:

$\%R = \frac{Found}{True} \times 100$ Where, Found = activity of each analyte measured in the analysis of the sample.
True = activity of each analyte in the source.

A matrix spike and matrix spike duplicate relative percent difference (RPD) was recalculated using the following formula:

$RPD = \frac{|S-D|}{(S+D)/2} \times 100$ Where, S = Original sample activity
D = Duplicate sample activity

Sample ID	Type of Analysis	Analyte	Found/S (units)	True/D (units)	Recalculated %R or RPD	Reported %R or RPD	Acceptable (Y/N)
LCS	Laboratory control sample	Th-230	2.05	2.00	102.5	85. 102.3	Y
N	Matrix spike sample						
20	Duplicate RPD	Th-230	0.601	0.694	14.36	14.36	Y
1	Chemical recovery	Th-229	% reported directly from raw data		100.3	100.26	Y

Comments: _____

TOTCLC.35

LDC #: 42662A73

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Page: 1 of 1
Reviewer: C
2nd reviewer: C

METHOD: Radiochemistry (Method: See cover)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

Y N N/A Have results been reported and calculated correctly?
Y N N/A Are results within the calibrated range of the instruments?

Analyte results for Th-232 reported with a positive detect were recalculated and verified using the following equation:

Concentration = $\frac{(cpm - background)}{2.22 \times E \times SA \times Vol}$

AS

Recalculation:

$282.333 / 2.22(0.1631)(0.872)(1000\ min)(1037\ l/g) =$

$0.8622\ pCi/g$

E = Counter Efficiency
SA = Self-absorbance factor
Vol = Volume of sample

#	Sample ID	Analyte	Reported Concentration (pCi/g)	Calculated Concentration (pCi/g)	Acceptable (Y/N)
	1	Th-227	0.0293	0.0173	Y
	2	Th-228	0.597	0.627	
	3	Th-230	0.760	0.857	
	4	Th-232	0.906	0.971	
	5	Th-227	0.0671	0.0418	
	6	Th-228	0.703	0.731	
	7	Th-230	1.87	2.58	
	8	Th-232	0.838	0.862	
	9	Th-227	0.0592	0.0425	
	10	Th-228	0.684	0.719	
	11	Th-230	0.961	1.09	
	12	Th-232	0.551	0.557	
	13	Th-227	0.0849	0.0556	
	14	Th-228	0.882	2.33	
	15	Th-230	1.29	1.49	
	16	Th-232	0.538	0.547	
	17	Th-227	0.0356	0.0414	
	18	Th-228	0.913	0.927	
	19	Th-230	0.769	0.848	

Note:

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: CRU Site, NY

LDC Report Date: March 4, 2020

Parameters: Gamma Spectroscopy

Validation Level: Level IV

Laboratory: National Analytical Radiation Environmental Laboratory

Sample Delivery Group (SDG): 1900153

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
RB-190908	B9.10556G	Water	09/08/19
RB-190909	B9.10557H	Water	09/09/19
RB-190908DUP	B9.10556GDUP	Water	09/08/19

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the Multi Agency Radiological Laboratory Analytical Protocols (MARLAP) Manual (July 2004) and a modified outline of the USEPA National Functional Guidelines (NFG) for Inorganic Superfund Methods Data Review (January 2017). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Gamma Spectroscopy by Method NAREL GAM-01

All sample results were subjected to Level IV data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The compound or analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The compound or analyte was analyzed for and positively identified by the laboratory; however the compound or analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The compound or analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected compound or analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition.

All technical holding time requirements were met.

II. Initial Calibration

All criteria for the initial calibration were met.

Counting and detector efficiency were determined for each detector and each radionuclide.

III. Continuing Calibration

Continuing calibration and background determination were performed at the required frequencies. Results were within laboratory control limits.

IV. Blanks

Laboratory blanks were analyzed as required by the method. Blank results contained less than the minimum detectable concentrations (MDC) with the following exceptions:

Blank ID	Isotope	Concentration	Associated Samples
PB (prep blank)	Thallium-208	3.87 pCi/L	All samples in SDG 1900153

Sample activities were compared to activities detected in the laboratory blanks. The sample activities were either not detected or were significantly greater (>5X blank activity) than the activities found in the associated laboratory blanks.

V. Field Blanks

Samples RB-190908 and RB-190909 were identified as rinsate blanks. No contaminants were found.

VI. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicates (MSD) analyses were not required by the method.

VII. Duplicate Sample Analysis

Duplicate (DUP) sample analysis was performed on an associated project sample. Results were within QC limits.

VIII. Laboratory Control Samples

Laboratory control samples (LCS) were analyzed as required by the method. Percent recoveries (%R) were within QC limits.

IX. Field Duplicates

No field duplicates were identified in this SDG.

X. Minimum Detectable Concentrations

All minimum detectable concentrations (MDC) met reporting limits (RL).

XI. Sample Result Verification

All sample result verifications were acceptable.

XI. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

The quality control criteria reviewed were met and are considered acceptable.

CRU Site, NY
Gamma Spectroscopy - Data Qualification Summary - SDG 1900153

No Sample Data Qualified in this SDG

CRU Site, NY
Gamma Spectroscopy - Laboratory Blank Data Qualification Summary - SDG 1900153

No Sample Data Qualified in this SDG

CRU Site, NY
Gamma Spectroscopy - Field Blank Data Qualification Summary - SDG 1900153

No Sample Data Qualified in this SDG

LDC #: 47161B35 **VALIDATION COMPLETENESS WORKSHEET** Date: 3/3/20
SDG #: 1900153 Level IV Page: 1 of 1
Laboratory: National Analytical Radiation Environmental Laboratory Reviewer: [illegible]
2nd Reviewer: [illegible]

METHOD: Gamma Spectroscopy (NAREL GAM -01)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A, A	
II.	Initial calibration	A	
III.	Calibration verification	A	
IV.	Laboratory Blanks	SW	
V.	Field blanks	SW/ND	RB=1,2
VI.	Matrix Spike/Matrix Spike Duplicates	N	not required
VII.	Duplicates	A	
VIII.	Laboratory control samples	A	LCS
IX.	Field duplicates	N	
X.	Minimum detectable activity (MDA)	A	
XI.	Sample result verification	A	
XII.	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID	Lab ID	Matrix	Date
1	RB-190908	B9.10556G	Water	09/08/19
2	RB-190909	B9.10557H	Water	09/09/19
3	RB-190908DUP	B9.10556GDUP	Water	09/08/19
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				

Notes:

All results < 2σ or < MDC

LDC #: 47161B35

VALIDATION FINDINGS CHECKLIST

Reviewer: CA
2nd Reviewer: CT

Method: Radiochemistry (EPA Method See cover)

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
All technical holding times were met.	✓			
II. Calibration				
Were all instruments and detectors calibration as required?	✓			
Were NIST traceable standards used for all calibrations?	✓			
Was the check source identified by activity and radionuclide?	✓			
Were check sources including background counts analyzed at the requiried frequency and within laboratory control limits?	✓			
III. Blanks				
Were blank analyses performed as required?	✓			
Were any activities detected in the blanks greater than the minimum detectable activity (MDA)? If yes, please see the Blanks validation completeness worksheet.	✓			
IV. Matrix spikes and Duplicates				
Were a matrix spike (MS) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD or MS/DUP. Soil / Water.			✓	
Were the MS percent recoveries (%R) within the QC limits? If the sample concentration exceeded the spike concentration by a factor of 4 or more, no action was taken.			✓	
Was a duplicate sample anaylzed at the required frequency of 5% in this SDG?	✓			
Were all duplicate sample duplicate error rations (DER) <1.42?.	✓			
V. Laboratory control samples				
Was an LCS analyzed per analytical batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the 75-125%	✓			
VI. Sample Chemical/Carrier Recovery				
Was a tracer/carrier added to each sample?			✓	
Were tracer/carrier recoveries within the QC limits?			✓	
VII. Regional Quality Assurance and Quality Control				
Were performance evaluation (PE) samples performed?		✓		
Were the performance evaluation (PE) samples within the acceptance limits?			✓	
VIII. Sample Result Verification				
Were activities adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✓			
Were the Minimum Detectable Activities (MDA) < RL?	✓			

Validation Area	Yes	No	NA	Findings/Comments
IX. Overall assessment of data				
Overall assessment of data was found to be acceptable.	✓			
X. Field duplicates				
Field duplicate pairs were identified in this SDG.		/		
Target analytes were detected in the field duplicates.			/	
XI. Field blanks				
Field blanks were identified in this SDG.	/			
Target analytes were detected in the field blanks.		/		

LDC #: 47161B35

VALIDATION FINDINGS WORKSHEET
Blanks

Reviewer: [illegible]
2nd Reviewer: [illegible]

METHOD: Radiochemistry, Method See Cover

Conc. units: pCi/L **Associated Samples:** All

Isotope	Blank ID	Blank Action Limit	Sample Identification										
	PB		No Qualifiers (ND)										
Tl-208	3.87												

CIRCLED RESULTS WERE NOT QUALIFIED. ALL RESULTS NOT CIRCLED WERE QUALIFIED BY THE FOLLOWING STATEMENT:
All contaminants within five times the method blank concentration were qualified as not detected, "U".

LDC #: 47161B35

VALIDATION FINDINGS WORKSHEET
Level IV Recalculation Worksheet

Reviewer: a
2nd Reviewer: a

METHOD: Radiochemistry (Method: see cover)

Percent recoveries (%R) for a laboratory control sample, a matrix spike and a matrix spike duplicate sample were recaluculated using the following formula:

$\%R = \frac{Found}{True} \times 100$ Where, Found = activity of each analyte measured in the analysis of the sample.
True = activity of each analyte in the source.

A matrix spike and matrix spike duplicate relative percent difference (RPD) was recalculated using the following formula:

$RPD = \frac{|S-D|}{(S+D)/2} \times 100$ Where, S = Original sample activity
D = Duplicate sample activity

Sample ID	Type of Analysis	Analyte	Found/S (units)	True/D (units)	Recalculated %R or RPD	Reported %R or RPD	Acceptable (Y/N)
LCS	Laboratory control sample	Ba-207	3940	3950	99.7	99.8	Y
	Matrix spike sample						
3	Duplicate RPD	K-40	ND	ND	-	-	Y
	Chemical recovery						

Comments: _____

TOTCLC.35

LDC #: 47161B35

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Page: 1 of 1
Reviewer: C
2nd reviewer: A

METHOD: Radiochemistry (Method: See cover)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

Y N N/A Have results been reported and calculated correctly?
Y N N/A Are results within the calibrated range of the instruments?

Analyte results for _____ reported with a positive detect were recalculated and verified using the following equation:

Concentration =

$$\frac{(cpm - background)}{2.22 \times E \times SA \times Vol}$$

E = Counter Efficiency
SA = Self-absorbance factor
Vol = Volume of sample

Recalculation:

All ND

#	Sample ID	Analyte	Reported Concentration ( )	Calculated Concentration ( )	Acceptable (Y/N)

Note: _____

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: CRU Site, NY

LDC Report Date: March 4, 2020

Parameters: Isotopic Uranium

Validation Level: Level IV

Laboratory: National Analytical Radiation Environmental Laboratory

Sample Delivery Group (SDG): 1900153

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
RB-190908	B9.10556G	Water	09/08/19
RB-190909	B9.10557H	Water	09/09/19
RB-190908DUP	B9.10556GDUP	Water	09/08/19

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the Multi Agency Radiological Laboratory Analytical Protocols (MARLAP) Manual (July 2004) and a modified outline of the USEPA National Functional Guidelines (NFG) for Inorganic Superfund Methods Data Review (January 2017). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Isotopic Uranium by Method NAREL U-EICHROM

All sample results were subjected to Level IV data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The compound or analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The compound or analyte was analyzed for and positively identified by the laboratory; however the compound or analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The compound or analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected compound or analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition.

All technical holding time requirements were met.

II. Initial Calibration

All criteria for the initial calibration were met.

Counting and detector efficiency were determined for each detector and each radionuclide.

III. Continuing Calibration

Continuing calibration and background determination were performed at the required frequencies. Results were within laboratory control limits.

IV. Blanks

Laboratory blanks were analyzed as required by the method. Blank results contained less than the minimum detectable concentrations (MDC).

V. Field Blanks

Samples RB-190908 and RB-190909 were identified as rinsate blanks. No contaminants were found with the following exceptions:

Blank ID	Sampling Date	Isotope	Activity	Associated Samples
RB-190908	09/08/19	Uranium-234	0.136 pCi/L	No associated samples in this SDG

VI. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicates (MSD) analyses were not required by the method.

VII. Duplicate Sample Analysis

Duplicate (DUP) sample analysis was performed on an associated project sample. Results were within QC limits.

VIII. Laboratory Control Samples

Laboratory control samples (LCS) were analyzed as required by the method. Percent recoveries (%R) were within QC limits with the following exceptions:

LCS ID	Isotope	%R (Limits)	Associated Samples	Flag	A or P
LCS	Uranium-235	160.1 (75-125)	All samples in SDG 1900153	NA	-

IX. Field Duplicates

No field duplicates were identified in this SDG.

X. Minimum Detectable Concentrations

All minimum detectable concentrations (MDC) met reporting limits (RL).

XI. Sample Result Verification

All sample result verifications were acceptable.

XI. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

The quality control criteria reviewed were met and are considered acceptable.

CRU Site, NY
Isotopic Uranium - Data Qualification Summary - SDG 1900153

No Sample Data Qualified in this SDG

CRU Site, NY
Isotopic Uranium - Laboratory Blank Data Qualification Summary - SDG 1900153

No Sample Data Qualified in this SDG

CRU Site, NY
Isotopic Uranium - Field Blank Data Qualification Summary - SDG 1900153

No Sample Data Qualified in this SDG

LDC #: 47161B59
SDG #: 1900153
Laboratory: National Analytical Radiation Environmental Laboratory

VALIDATION COMPLETENESS WORKSHEET
Level IV

Date: 3/3/20
Page: 1 of 1
Reviewer: G
2nd Reviewer: G

METHOD: Isotopic Uranium (NAREL U-EICHROM)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A/A	
II.	Initial calibration	A	
III.	Calibration verification	A	
IV.	Laboratory Blanks	A	
V.	Field blanks	SW	RB=1,2*
VI.	Matrix Spike/Matrix Spike Duplicates	N	not required
VII.	Duplicates	A	
VIII.	Laboratory control samples	SW	LCS
IX.	Field duplicates	N	
X.	Tracer Recovery	A	
XI.	Minimum detectable activity (MDA)	A	
XII.	Sample result verification	A	
XIII.	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; * ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID	Lab ID	Matrix	Date
1	RB-190908	B9.10556G	Water	09/08/19
2	RB-190909	B9.10557H	Water	09/09/19
3	RB-190908DUP	B9.10556GDUP	Water	09/08/19
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				

Notes:

Method: Radiochemistry (EPA Method See cover)

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
All technical holding times were met.	✓			
II. Calibration				
Were all instruments and detectors calibration as required?	✓			
Were NIST traceable standards used for all calibrations?	✓			
Was the check source identified by activity and radionuclide?	✓			
Were check sources including background counts analyzed at the requiried frequency and within laboratory control limits?		✓		
III. Blanks				
Were blank analyses performed as required?	✓			
Were any activities detected in the blanks greater than the minimum detectable activity (MDA)? If yes, please see the Blanks validation completeness worksheet.		✓		
IV. Matrix spikes and Duplicates				
Were a matrix spike (MS) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD or MS/DUP. Soil / Water.			✓	
Were the MS percent recoveries (%R) within the QC limits? If the sample concentration exceeded the spike concentration by a factor of 4 or more, no action was taken.			✓	
Was a duplicate sample anaylzed at the required frequency of 5% in this SDG?	✓			
Were all duplicate sample duplicate error rations (DER) <1.42?.	✓			
V. Laboratory control samples				
Was an LCS analyzed per analytical batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the ~~75-125%~~ QC limits		✓		
VI. Sample Chemical/Carrier Recovery				
Was a tracer/carrier added to each sample?	✓			
Were tracer/carrier recoveries within the QC limits?	✓			
VII. Regional Quality Assurance and Quality Control				
Were performance evaluation (PE) samples performed?		✓		
Were the performance evaluation (PE) samples within the acceptance limits?			✓	
VIII. Sample Result Verification				
Were activities adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✓			
Were the Minimum Detectable Activities (MDA) < RL?	✓			

Validation Area	Yes	No	NA	Findings/Comments
IX. Overall assessment of data				
Overall assessment of data was found to be acceptable.	✓			
X. Field duplicates				
Field duplicate pairs were identified in this SDG.		✓		
Target analytes were detected in the field duplicates.			✓	
XI. Field blanks				
Field blanks were identified in this SDG.	✓			
Target analytes were detected in the field blanks.	✓			

LDC #: 47161B59

VALIDATION FINDINGS WORKSHEET
Field Blanks

Reviewer:
2nd Reviewer:

METHOD: Radiochemistry, Method See Cover
Blank units: pCi/L **Associated sample units:** pCi/L
Sampling date: 9/8/19
Field blank type: (circle one) Field Blank / Rinsate / Other: Associated Samples: None

Analyte	Blank ID	Action Limit	Sample Identification							
	1									
U-234	0.136									

CIRCLED RESULTS WERE NOT QUALIFIED. ALL RESULTS NOT CIRCLED WERE QUALIFIED BY THE FOLLOWING STATEMENT:
Samples with analyte concentrations within five times the associated field blank concentration are listed above, these sample results were qualified as not detected, "U".

LDC #: 47161B55

VALIDATION FINDINGS WORKSHEET
Laboratory Control Sample (LCS)

Page: 1 of 1
Reviewer:
2nd Reviewer:

METHOD: Radiochemistry (Method: see cover)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

Y N N/A Was a laboratory control sample (LCS) analyzed at the required frequency in this SDG?

Y (N) N/A Were all LCS and LCSD percent recoveries (%R) within the control limits ~~of 75-125% and RPD <20%?~~

LEVEL IV ONLY:

(Y) N N/A Were recalculated results acceptable? See Level IV Recalculation Worksheet for recalculations.

#	LCS/LCSD ID	Matrix	Analyte	LCS %R (limits)	LCSD %R (limits)	RPD (limits)	Associated Samples	Qualifications
	LCS	W	U-235	160.1 (~~>upper control limit~~) (75-125)			All	Jdet/P(M)

Comments:

LCSD.wpd

LDC #: 47161B57

VALIDATION FINDINGS WORKSHEET
Level IV Recalculation Worksheet

Reviewer: [illegible]
2nd Reviewer: [illegible]

METHOD: Radiochemistry (Method: see cover)

Percent recoveries (%R) for a laboratory control sample, a matrix spike and a matrix spike duplicate sample were recaluculated using the following formula:

$\%R = \frac{Found}{True} \times 100$ Where, Found = activity of each analyte measured in the analysis of the sample.
True = activity of each analyte in the source.

A matrix spike and matrix spike duplicate relative percent difference (RPD) was recalculated using the following formula:

$RPD = \frac{|S-D|}{(S+D)/2} \times 100$ Where, S = Original sample activity
D = Duplicate sample activity

Sample ID	Type of Analysis	Analyte	Found/S (units)	True/D (units)	Recalculated %R or RPD	Reported %R or RPD	Acceptable (Y/N)
LCS	Laboratory control sample	U-238	2.06	2.02	102.0	102.1	Y
	Matrix spike sample						
3	Duplicate RPD	U-235	ND	ND	—	—	Y
1	Chemical recovery	U-232	From raw data		91.8	91.84	Y

Comments: _____

LDC #: 47161B59

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Page: 1 of 1
Reviewer: C
2nd reviewer: CK

METHOD: Radiochemistry (Method: See cover)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

Y N N/A Have results been reported and calculated correctly?
Y N N/A Are results within the calibrated range of the instruments?

Analyte results for U-234 reported with a positive detect were recalculated and verified using the following equation:

Concentration = $\frac{(cpm - background)}{2.22 \times E \times SA \times Vol}$

Recalculation:

$\frac{9}{2.22(1000\ min)(0.162)(0.2\ L)(0.918)} = 0.1363\ pCi/L$

E = Counter Efficiency
SA = Self-absorbance factor
Vol = Volume of sample

#	Sample ID	Analyte	Reported Concentration (pCi/L)	Calculated Concentration (pCi/L)	Acceptable (Y/N)
	1	U-234	0.136	0.136	Y

Note:

RECALC.35

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: CRU Site, NY

LDC Report Date: March 4, 2020

Parameters: Isotopic Thorium

Validation Level: Level IV

Laboratory: National Analytical Radiation Environmental Laboratory

Sample Delivery Group (SDG): 1900153

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
RB-190908	B9.10556G	Water	09/08/19
RB-190909	B9.10557H	Water	09/09/19
RB-190908DUP	B9.10556GDUP	Water	09/08/19

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with the Multi Agency Radiological Laboratory Analytical Protocols (MARLAP) Manual (July 2004) and a modified outline of the USEPA National Functional Guidelines (NFG) for Inorganic Superfund Methods Data Review (January 2017). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Isotopic Thorium by Method NAREL TH-EICHROM

All sample results were subjected to Level IV data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The compound or analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The compound or analyte was analyzed for and positively identified by the laboratory; however the compound or analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The compound or analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected compound or analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition.

All technical holding time requirements were met.

II. Initial Calibration

All criteria for the initial calibration were met.

Counting and detector efficiency were determined for each detector and each radionuclide.

III. Continuing Calibration

Continuing calibration and background determination were performed at the required frequencies. Results were within laboratory control limits.

IV. Blanks

Laboratory blanks were analyzed as required by the method. Blank results contained less than the minimum detectable concentrations (MDC).

V. Field Blanks

Samples RB-190908 and RB-190909 were identified as rinsate blanks. No contaminants were found.

VI. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicates (MSD) analyses were not required by the method.

VII. Duplicate Sample Analysis

Duplicate (DUP) sample analysis was performed on an associated project sample. Results were within QC limits.

VIII. Laboratory Control Samples

Laboratory control samples (LCS) were analyzed as required by the method. Percent recoveries (%R) were within QC limits.

IX. Field Duplicates

No field duplicates were identified in this SDG.

X. Minimum Detectable Concentrations

All minimum detectable concentrations (MDC) met reporting limits (RL).

XI. Sample Result Verification

All sample result verifications were acceptable.

XI. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

The quality control criteria reviewed were met and are considered acceptable.

CRU Site, NY
Isotopic Thorium - Data Qualification Summary - SDG 1900153

No Sample Data Qualified in this SDG

CRU Site, NY
Isotopic Thorium - Laboratory Blank Data Qualification Summary - SDG 1900153

No Sample Data Qualified in this SDG

CRU Site, NY
Isotopic Thorium - Field Blank Data Qualification Summary - SDG 1900153

No Sample Data Qualified in this SDG

LDC #: 47161B73 **VALIDATION COMPLETENESS WORKSHEET** Date: 3/3/20
SDG #: 1900153 Level IV Page: 1 of 1
Laboratory: National Analytical Radiation Environmental Laboratory Reviewer: A
2nd Reviewer: A

METHOD: Isotopic Thorium (NAREL TH-EICHROM)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A	
II.	Initial calibration	A	
III.	Calibration verification	A	
IV.	Laboratory Blanks	A	
V.	Field blanks	ND	RB=1, 2
VI.	Matrix Spike/Matrix Spike Duplicates	N	Not required
VII.	Duplicates	A	
VIII.	Laboratory control samples	A	LCS
IX.	Field duplicates	N	
X.	Tracer Recovery	A	
XI.	Minimum detectable activity (MDA)	A	
XII.	Sample result verification	A	
XIII.	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID	Lab ID	Matrix	Date
1	RB-190908	B9.10556G	Water	09/08/19
2	RB-190909	B9.10557H	Water	09/09/19
3	RB-190908DUP	B9.10556GDUP	Water	09/08/19
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				

Notes:

results < MDC or < 2σ

Method: Radiochemistry (EPA Method See cover)

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
All technical holding times were met.	✓			
II. Calibration				
Were all instruments and detectors calibration as required?	✓			
Were NIST traceable standards used for all calibrations?	✓			
Was the check source identified by activity and radionuclide?				
Were check sources including background counts analyzed at the requiried frequency and within laboratory control limits?	✓			
III. Blanks				
Were blank analyses performed as required?	✓			
Were any activities detected in the blanks greater than the minimum detectable activity (MDA)? If yes, please see the Blanks validation completeness worksheet.		✓		
IV. Matrix spikes and Duplicates				
Were a matrix spike (MS) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD or MS/DUP. Soil / Water.			✓	
Were the MS percent recoveries (%R) within the QC limits? If the sample concentration exceeded the spike concentration by a factor of 4 or more, no action was taken.			✓	
Was a duplicate sample anaylzed at the required frequency of 5% in this SDG?	✓			
Were all duplicate sample duplicate error rations (DER) ≤1.42?.	✓			
V. Laboratory control samples				
Was an LCS analyzed per analytical batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the 75-125%	✓			
VI. Sample Chemical/Carrier Recovery				
Was a tracer/carrier added to each sample?	✓			
Were tracer/carrier recoveries within the QC limits?	✓			
VII. Regional Quality Assurance and Quality Control				
Were performance evaluation (PE) samples performed?		✓		
Were the performance evaluation (PE) samples within the acceptance limits?			✓	
VIII. Sample Result Verification				
Were activities adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✓			
Were the Minimum Detectable Activities (MDA) < RL?	✓			

Validation Area	Yes	No	NA	Findings/Comments
IX. Overall assessment of data				
Overall assessment of data was found to be acceptable.	✓			
X. Field duplicates				
Field duplicate pairs were identified in this SDG.		✓		
Target analytes were detected in the field duplicates.			✓	
XI. Field blanks				
Field blanks were identified in this SDG.	✓	✓		
Target analytes were detected in the field blanks.				

LDC #: 9716B73

VALIDATION FINDINGS WORKSHEET
Level IV Recalculation Worksheet

Reviewer: a
2nd Reviewer: a

METHOD: Radiochemistry (Method: see cover)

Percent recoveries (%R) for a laboratory control sample, a matrix spike and a matrix spike duplicate sample were recaluculated using the following formula:

$\%R = \frac{Found}{True} \times 100$ Where, Found = activity of each analyte measured in the analysis of the sample.
True = activity of each analyte in the source.

A matrix spike and matrix spike duplicate relative percent difference (RPD) was recalculated using the following formula:

$RPD = \frac{|S-D|}{(S+D)/2} \times 100$ Where, S = Original sample activity
D = Duplicate sample activity

Sample ID	Type of Analysis	Analyte	Found/S (units)	True/D (units)	Recalculated %R or RPD	Reported %R or RPD	Acceptable (Y/N)
LCS	Laboratory control sample	Th-230	2.08	1.99	104.5	104.5	Y
	Matrix spike sample						
3	Duplicate RPD	Th-227	ND	ND	—	—	Y
1	Chemical recovery	~~Th-234~~ Th-229	Taken directly from raw data		96.9	96.89	Y

Comments: _____

LDC #: 47161B73

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Page: 1 of 1
Reviewer: C
2nd reviewer: CA

METHOD: Radiochemistry (Method: See cover)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

Y N N/A Have results been reported and calculated correctly?
Y N N/A Are results within the calibrated range of the instruments?

Analyte results for _____ reported with a positive detect were recalculated and verified using the following equation:

Concentration =

$$\frac{(cpm - background)}{2.22 \times E \times SA \times Vol}$$

E = Counter Efficiency
SA = Self-absorbance factor
Vol = Volume of sample

Recalculation:

all ND

#	Sample ID	Analyte	Reported Concentration ( )	Calculated Concentration ( )	Acceptable (Y/N)

Note: _____

RECALC.35